Space Weather Technical Forecast

Issued on Saturday 28 September 2024 at 13:22 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-flares (R1-R2 Blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with a peak C6.2 flare observed at 27/1506 UTC from AR3842. There are currently eleven sunspot regions on the visible disc, the majority of which are magnetically simple and inactive. The largest region currently on the visible disc is AR3842 (Fki/Beta-Gamma) in the far southeast. As it rotates into clearer view a large asymmetric spot is evident in the leading portion of the group, with a number of smaller intermediate and trailing mixed polarity spots. The next largest region AR3836 (Hsx/Alpha), also in the southeast disc, underwent decay in its trailing region to leave a unipolar region, but with a reasonable number of negative polarity spots still evident. AR3835 (Dai/Beta) west of centre disc in the southern hemisphere contains moderate magnetic complexity with slow development in its intermediate and trailing regions, but is largely inactive at this time.

There were no Earth-directed CMEs observed.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by ACE at L1, were largely indicative of a normal background regime, though likely with some minor CME influence from around 28/0700 UTC. Speeds remained at slow-ambient levels, declining from 350km/s to around 300km/s, before rising again to vary between 300-360km/s following the CME arrival. Density was largely below average, but briefly became average following passage of the CME. Interplanetary Magnetic Field, Bt, was mainly weak, at or below 7nT, but rose to Moderate levels for a time later in the period, with a peak of 9nT observed at 28/1026 UTC. The north-south component, Bz, was predominantly weakly positive, but after 28/0700 UTC was weak and generally negative in direction (peak -7nT). Phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2) throughout.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 was at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels for much of the period, but increased to become Moderate after 28/0830 UTC. The associated 24-hour fluence was below the Active threshold and has been on a declining, then steady trend. The 28/0000 UTC observation was 7.04e6 integrated pfu.

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Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with a chance of further isolated M-class flares. New regions are expected to rotate onto the disc during the period.

Solar Wind / Geomagnetic Activity: No Earth directed CMEs are currently expected. Background solar winds are expected until a possible weak enhancement occurs, from CH76/-, with wind speeds perhaps reaching around 450km/s. The fast wind onset is expected late on Day 1 or during Day 2 (28-29 Sep).

Mainly Quiet (Kp 0-2) geomagnetic conditions are expected. Ongoing CME effects or the onset of any HSS from CH76/- could bring Unsettled to Active (Kp 3-4) intervals during Days 1 and Day 2.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is forecast to persist at background levels with just a very slight chance of solar radiation storms occurring. High energy electron flux at GOES16 is currently ranging between normal background and Moderate levels and likely to remain similar through Days 1 and 2 (28 and 29 Sep). Some increase is possible by Day 4 (01 Oct) but is dependent on HSS enhancement and as such is low confidence. The associated 24 hour fluence is expected to remain below Active (1e8 integrated pfu) throughout.

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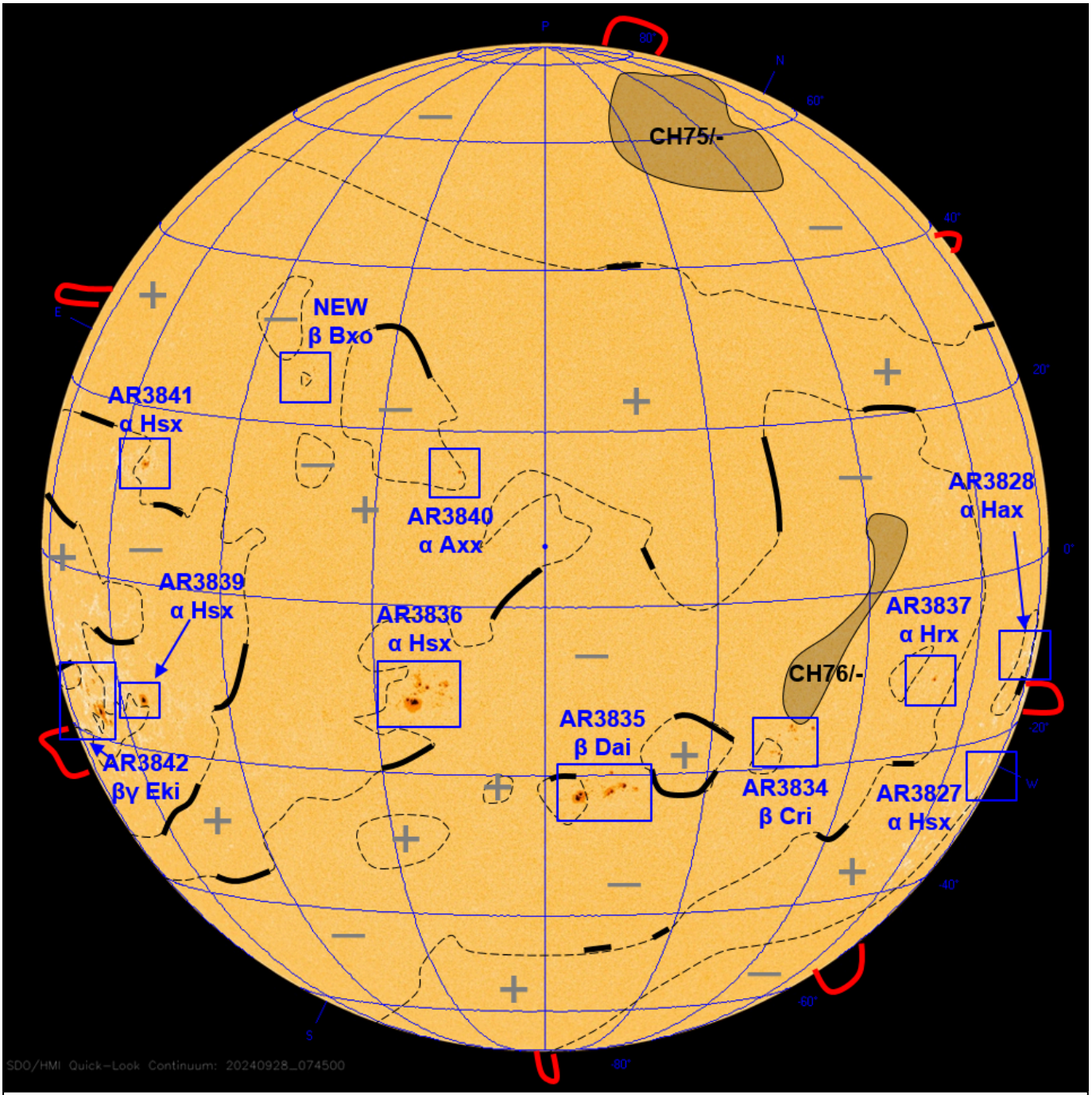
Figure 1: MOSWOC Solar Synoptic Map valid 28/0745 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No Earth-directed CMEs feature in the forecast.

Ongoing minor CME influence is expected to ease early in the period. Current background solar winds are expected to persist until a possible weak enhancement occurs from the arrival of a HSS from CH76/-. This persistent feature lies across the solar equator in the western hemisphere and is expected to connect late on Day 1 (28 Sep) or more probably during Day 2 (29 Sep). On the previous rotation wind speeds of around 450km/s were observed with similar speeds expected this time. As a negative polarity feature, the high speed stream (HSS) is not favoured for a strong connection at Earth so close to the September equinox. MOSWOC Enlil is indicating a strong HSS to develop during this period, but this is considered unlikely with no large coronal holes visible on the disc. SWPM is considered to be giving a reasonable steer during the period, with the coronal hole feature represented in the slight uptick in wind values Days 1-2.

Mainly Quiet (Kp 0-2) geomagnetic conditions are expected. Ongoing minor CME effects and or the onset of any HSS from CH76/- could bring Unsettled to Active (Kp 3-4) intervals during Days 1 and Day 2.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Radio Blackouts - X-Ray Flares

Solar activity is Low with the largest flare measuring C6.2, observed at 27/1506 UTC from AR3842.

There are currently eleven sunspot regions on the Earth-facing disc, including one unnumbered region in the northeast. The largest region on the disc is AR3842 in the southeast. As it rotates into clearer view a large asymmetric spot is found in the leading portion of the group, with a number of smaller intermediate and trailing mixed polarity spots. The region is crackling with low-level C-class flares and the magnetic looping and canopy on SDO/AIA imagery would suggest there is the potential for larger flares.

AR3836, also in the southeast is an unusual group, in that it contains a reasonable number of small to moderately sized spots, but all of a singular polarity. Faint pores are just visible in the trailing region and these could redevelop to make this a bipolar group again in future. AR3839, west of AR3842 has been separated from the latter and is a simple, mature group. AR3835 near centre disc in the southern hemisphere contains moderate magnetic complexity with slow development in its intermediate and trailing regions.

The remaining sunspot groups on the disc are magnetically simple with limited flaring or change in appearance.

Regions AR3827 and AR3828, both in the far southwest, are due to depart the visible disc during Days 1 and 2 (28 and 29 Sep) respectively. From far side soundings and brightness on SDO imagery close to the eastern limb, it is likely there are further regions to rotate onto the disc during the period, however until they become visible it is difficult to assess how much they are likely to affect solar activity. At the present time, flare risks have been maintained. Low to Moderate activity is expected with a chance of isolated M-class flares.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	50	50	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

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Figure 2: GOES16 and GOES18 X-ray flux during the past 24-hours.

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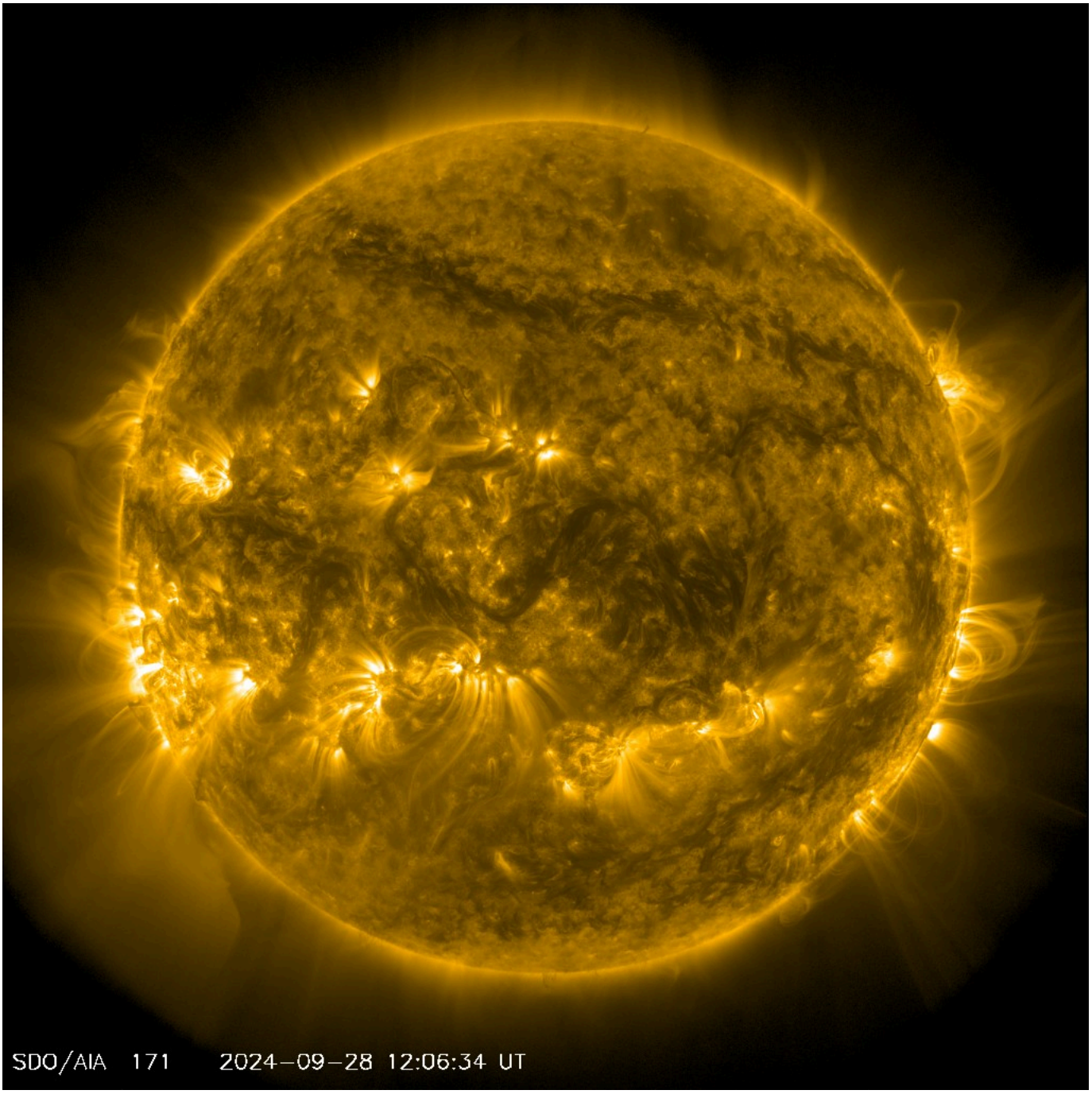
Figure 3: SDO/AIA 171 imagery at 28/1206 UTC.



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Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is forecast to persist at background levels, with only a very slight chance of rising above the S1/Minor Radiation Storm threshold.

The current visible sunspots are generally small and simple providing only modest contributions to flare risk, and are unlikely to significantly impact proton flux at Earth. However, given the number of notable filaments currently on the disc, there is also a very low chance of observable protons should any significant filament eruption occur during the period.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) observed by GOES16 is currently ranging between normal background to Moderate levels. Any fast wind enhancement from CH76/- is likely to suppress the observed flux during Days 1-2 (28-29 Sep) with some recovery anticipated by Day 4 (01 Oct). Thereafter, diurnal fluctuations of background to Moderate are most likely, perhaps seeing a diurnal peak of High towards the end of the period following any HSS enhancement.

The associated 24 hour fluence is currently below the Active threshold on a decreasing then increasing trend. MOSWOC REFM forecast values largely mirror the observed fluence pattern during 28 Sep and is considered reasonable guidance through the period. Fluence levels are very unlikely to reach Active. Confidence is lower than usual at this time for Day 3-4 due to the likely weak HSS onset.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}sr^{-1}day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ 1×10^{8}**	No	1	1	5	5
Very Active	**≥ 2 MeV ≥ 1×10^{9}**	No	1	1	1	1

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Figure 4: GOES16 >2MeV Electron Flux (above) and MOSWOC REFM forecast and Recurrence (below)

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